

Claims 1 (independent; previously amended) and 2 - 8 and 21 (dependent on 1), all directed to a method of making an aluminum reduction cell component having a stabilized surface that is wettable by molten aluminum, are in the application. All the claims have been finally rejected under 35 U.S.C. §103(a) as unpatentable over the “admitted prior art” in view of CA 2 350 814 A1 (Bergeron et al.) and U.S. patent No. 5,227,045 (Townsend). The final Office Action states that the “admitted prior art” is found on pp. 1-3 of applicants' specification.²

Present claim 1 recites a method which comprises

“mixing together a carbonaceous material, TiB_2 and up to 25% by weight of an additive consisting of a combination of two intimately mixed compounds and baking the mixture into a cell component having a baked surface provided with pores, wherein said TiB_2 is used in an amount sufficient to make the baked surface wettable by molten aluminum, and wherein at least a first of the two compounds has a higher melting temperature than the baking temperature, whereby when the cell component is contacted with molten aluminum, the aluminum wets the baked surface, penetrates the pores therein, and reacts with the additive to form a dense phase having low solubility in aluminum that seals the pores.”

As the specification explains, in aluminum reduction cells the use of cathode blocks containing metal borides such as TiB_2 is advantageous in making the cathode wettable by aluminum and in reducing cathode erosion. During cell operation, however, metal borides gradually leach out of the cathodes, leading to “a contamination of the metal product and a progressive erosion of the cathode blocks” (p. 1, lines 21-28; p. 2, line 22 - p. 3, line 2). The method invention defined in claim 1 overcomes this problem because

²This “Background” portion of the specification also discusses (at p. 2, lines 13-21) WO 00/29644, the PCT counterpart of Bergeron et al.

“During aluminum reduction, liquid aluminum wets the cathode via open pores. In the pores, the liquid aluminum reacts with the additive mixture to form a dense phase that seals the open pores of the cathode and stabilizes the carbon matrix around the TiB_2 particles of the carbon- TiB_2 aggregate” (p. 3, lines 23-29)

thereby reducing “the rate at which TiB_2 particles leach out of the cathode” (p. 8, lines 27-28).

In the claimed method, the TiB_2 makes the carbonaceous material wettable by molten aluminum. If not enough TiB_2 is present, the surface will not be wettable and the molten aluminum will not penetrate the open pores at the surface and undergo the required reaction to seal the pores. On the other hand, if the additive mixture is not present, there will again be no pore-sealing reaction because there is nothing for the aluminum to react with. Consequently, the limitations of claim 1 to “up to 25% by weight of an additive” as defined, in combination with TiB_2 “in an amount sufficient to make the baked surface wettable by molten aluminum,” are critical to the attainment of the advantageous results of applicants’ invention, viz. the reduction in the rate at which TiB_2 particles leach out of the cathode.

This claimed combination of features is clearly novel. The “admitted prior art,” as applied in the final rejection, merely “shows that a process for making cathodes for an aluminum reduction cell by forming a composite of a carbon-containing component and a metal boride such as titanium diboride is known”; hence, the “admitted prior art” does not teach the combination of sufficient TiB_2 to make the surface wettable by aluminum with any additive. Bergeron et al. describes a combination of an additive mixture (“precursor oxide mixture”) with carbonaceous material but includes at most only a small “amount of TiB_2 powder (e.g. 3%-10%) . . . to increase the kinetic of TiB_2 formation during cell operation” (Bergeron et al., p. 13, lines 7-11). This amount of TiB_2 is far less than that required to make the carbonaceous material wettable by molten aluminum (see Bergeron et al. at p. 10, lines 7-9; Townsend at col. 5, lines 28-33); thus, again, Bergeron et al. does not teach any combination of the additive mixture with sufficient TiB_2 to make the surface wettable by molten aluminum. Townsend is relied on only as teaching the amount of TiB_2 needed to bring about wettability (see final Office Action, pp. 3-4) and likewise fails to disclose the combination of the additive compounds therewith before baking the mixture into a cell component as applicants’ claim 1 requires.

The Examiner asserts that it would have been obvious to provide “sufficient titanium diboride so that the . . . composite component was wettable because both the admitted prior art and Townsend teach that wettability is an important characteristic,” and obvious “to have replaced a portion of the titanium diboride . . . of the admitted prior art with precursors . . . as taught by Bergeron et al. because the cost of the finished cathode would have been reduced” (final Office Action, p. 7). But the teaching of Bergeron et al. is to provide substantially all the titanium diboride in the form of precursors which are reacted *in situ*, so as to maximize cost savings, and to include TiB₂ in the initial mixture (if at all) only in an amount that is small in relation to the amount of precursors present (Bergeron et al., p. 11, lines 8-15; p. 13, lines 2-11), and only for the purpose of increasing the kinetic of TiB₂ formation during cell operation. In contrast, applicants’ claimed invention employs an initial mixture that contains more TiB₂ than additive/precursor. No reason is seen in the references for providing a starting mixture in these relative proportions.

But even assuming *arguendo* that the applied items of prior art, taken together, could be said to make the method of claim 1 *prima facie* obvious, nevertheless it is well settled that *prima facie* obviousness of a novel combination may be overcome if the combination achieves unexpected beneficial results. Here, the novel combination of sufficient TiB₂ in the starting material to make the baked surface wettable by molten aluminum with a minor proportion (up to 25% by weight) of the defined additive overcomes a problem – leaching of boride from the produced cell component, and consequent contamination of the molten metal and progressive erosion of the component – that is not even intimated in the applied prior art. This solution of an unmentioned problem is clearly unexpected and beneficial.

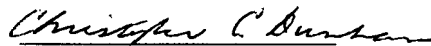
As demonstrating the unexpected result of the invention, attention is directed to the attached Declaration under 37 C.F.R. §1.132, describing a test comparing a carbonaceous cathode material containing 50% TiB₂ by weight and no additive with a carbonaceous cathode material containing 35% TiB₂ by weight and a stoichiometrical mixture of TiO₂/B₂O₃ equivalent to 15% by weight of TiB₂. After being subjected to electrolysis under conditions simulating aluminum reduction cell operation, “The mixture containing partial substitution with the oxide mixture [i.e., exemplifying the additive of claim 1] . . . shows superior erosion resistance (i.e., 1 mm of erosion

compared to greater than 5 mm erosion for the [50% TiB₂, no additive] . . . material." Nothing in the teachings of the applied prior art, taken together, would have made this result expected or obvious.

It is therefore submitted that the recital of the combination of features discussed above, in applicants' claim 1, distinguishes patentably over the admitted prior art, Bergeron et al. and Townsend, however combined. Claims 2 - 8 and 21, by virtue of their dependence on claim 1, are submitted to be allowable as well.

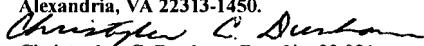
For the foregoing reasons, it is believed that this application is now in condition for allowance. Favorable action thereon is accordingly courteously requested.

Respectfully,



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